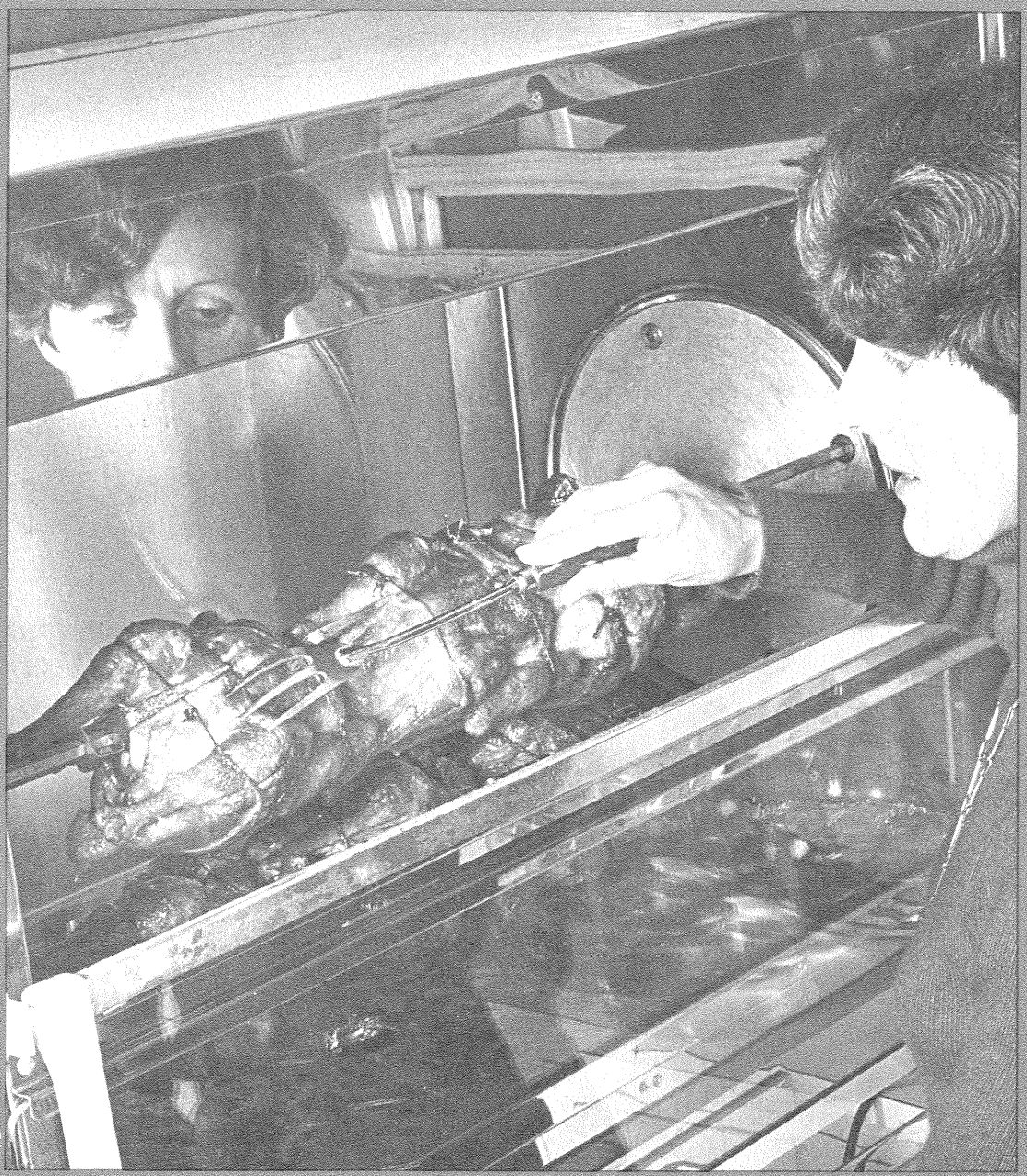
Vol. 37 No. 3 September 1977

CSIRO Food Research Quarterly



How should frozen chicken be roasted?

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It is generally recognized that the time and temperature of cooking influence the eating quality of chicken. However, there may be other factors associated with the preparation and cooking of frozen chickens, e.g. thawing, which affect the appearance, flavour and texture of the roasted bird.

Although frozen chicken has been accepted by consumers for years, little or no work has been published on the effect of commonly used preparative and roasting procedures on the eating quality of chicken. This investigation was undertaken to answer the following questions:

- Wrapping—how is the eating quality of a chicken modified by roasting it in aluminium foil or in a polyester oven bag?
- Thawing—is it necessary to thaw a frozen chicken before roasting?
- Method of thawing—does the method of thawing affect the sensory properties of a cooked chicken?
- Cleaning and trimming—does cleaning and trimming of the carcass before roasting change the acceptability of chicken?

Much uncertainty surrounds the value of the above practices and this is reflected in the few studies that have been published. Mickelberry and Stadelman (1960) found that chickens wrapped during cooking were more tender than those cooked without wrapping, but Deethardt *et al.* (1971) claimed that foil-wrapped chickens were less juicy. Fulton and Davis (1974) and Cunningham and Lee (1975) failed to find any advantage in thawing before cooking, but Stadelman (1960) found that thawed chickens were more tender. The method of thawing is of no consequence according to Berry *et al.* (1949), Hoffert *et al.* (1952), Brodine and Carlin (1968) and Korslund and Essary (1971), as all reported that taste panels found no difference between chickens thawed in various ways. However, it should be noted that in all instances small panels were used and they may have been lacking in sensitivity. In the light of these inadequate and sometimes conflicting results, it is not surprising that directions in cookbooks are often found to be contradictory.

Sensory methods

Commercially produced and processed frozen chickens were delivered to the CSIRO Food Research Laboratory at North Ryde individually packaged in Cryovac pouches. The birds were metric sizes 9 (*c.* 900 g) and 15 (*c.* 1·5 kg). They were of the same strain and reared under identical conditions within the one battery. The chickens were stored at −20°C until they were required for testing.

Details of the sensory methods used in the four parts of the investigation are summarized in Table 1. For all sensory tests the chickens were cut, after roasting, into six anatomical portions (2 legs, 2 thighs, 2 breast pieces) for taste testing. A complete block design was used within each part; every member of the taste panel receiving one piece of chicken from each of the experimental treatments at each tasting session. Each taster always received pieces of chicken from the same anatomical region. The panel was also divided into a number of subgroups so that each subgroup assessed chicken pieces from the same carcass, thus providing a measure of within-carcass variability. All panelists had had previous experience in sensory evaluation but none had any special knowledge of assessing chicken. The chicken pieces were served hot, without condiments, to the tasters who were seated in individual booths in the tasting laboratory, under normal lighting. The tasters were required to assess sensory quality

Table 1. Summary of experimental methods

Treatment	Cooking regime	Metric size of bird	No. on panel	No. of sessions per taster	No. of samples per session
Experiment 1					
1 Roasted unwrapped 2 Roasted wrapped in Alfoil 3 Roasted in oven bags	Domestic oven 2 h at 180°C	15	24	3	3
Experiment 2a					
1 Cooked from frozen 2½ h 2 Cooked from frozen 2 h 3 Cooked after thawing 1½ h	Domestic oven at 180°C	9	36	1	3
Experiment 2b					
1 Cooked from frozen 3 h 2 Cooked from frozen 2½ h 3 Cooked after thawing 2 h	Domestic oven at 180°C	15	36	1	3
Experiments 3a and b					
1 Thawed for 24 h at 5°C wrapped and unwrapped 2 Thawed for 12 h at 20°C wrapped and unwrapped 3 Thawed for 2 h in running water at 15°C wrapped and unwrapped	Rotisserie 2 h at 180°C	15	24	6	3
Experiment 4					
1 Cooked without cleaning or trimming 2 Carcasses trimmed of excess fat/skin before cooking 3 Cavity washed before cooking 4 Carcasses trimmed and cavity washed before cooking	Rotisserie 2 h at 180°C	9	24	4	4

on a nine-point hedonic scale—(like extremely=9, dislike extremely=1).

Unless stated otherwise, the chickens were thawed (still in their Cryovac pouches) in air at 5°C for 24 h; in experiments 1 and 2, a conventional domestic oven was used for cooking, and in experiments 3 and 4 an electric rotisserie (Austheat Pty Ltd) was used with four bars and capacity to cook up to 16 chickens simultaneously.

Results

Data from all experiments were subjected to separate analyses of variance by means of the GENSTAT system. Table 2 contains means for each experimental treatment on all the variates assessed. Other effects such as differences between anatomical parts of chickens, differences between tasters and interactions were computed and although they are not listed in Table 2 they will be discussed later.

Effect of wrapping (experiment 1)

The textures of chickens roasted while wrapped in aluminium foil and oven bags were similar and were preferred ($P < 0{\cdot}05$) to chickens cooked unwrapped. Panelists commented that the chickens that were wrapped during roasting were *more tender* and *juicier* than the unwrapped chickens. Tasters detected no significant differences between samples for colour or general acceptability, although there was a tendency for the colour of the chickens cooked unwrapped to be preferred. These results are intuitively reasonable; wrapping could be expected to allow greater retention of natural juices but at the same time inhibit browning during cooking.

Table 2. Summary of results from the panels of sensory assessors

Treatment	Colour	Flavour	Texture	General acceptability	Degree of cooking[B]
		Hedonic scale 1–9[A]			
Experiment 1					
1 Roasted unwrapped	7·2	6·9	5·8x	6·8	
2 Roasted wrapped in Alfoil	6·9	6·8	6·6y	6·6	NA
3 Roasted in oven bags	7·0	7·0	6·3y	6·6	
LSD	NS	NS	0·4*	NS	
Experiment 2a					
1 Cooked from frozen 2½ h	7·2	6·7	5·9x		4·3x
2 Cooked from frozen 2 h	7·4	6·8	6·1x	NA	5·1y
3 Cooked after thawing 1½ h	7·6	7·2	7·1y		5·0y
LSD	NS	NS	0·8*		0·3***
Experiment 2b					
1 Cooked from frozen 3 h	6·5	6·3	6·0x		4·9
2 Cooked from frozen 2½ h	6·9	6·6	5·9x	NA	4·8
3 Cooked after thawing 2 h	7·1	6·4	7·0y		4·9
LSD	NS	NS	0·7*		NS

Experiments 3a and b	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	
1 Thawed for 24 h at 5°C	7·2	6·8	6·4x	6·8	6·8	6·7	6·4x	6·7	
2 Thawed for 12 h at 20°C	7·4	6·9	7·0y	6·9	6·7	6·8	6·9y	6·8	
3 Thawed for 2 h in running water at 15°C	7·1	6·8	6·7z	6·9	6·7	6·9	6·6x	6·8	
LSD	NS	NS	0·3***	NS	NS	NS	0·3***		NA
Thawed wrapped	7·3	6·9	7·0x	6·9	6·8	6·8	6·9x	6·8	
Thawed unwrapped	7·2	6·8	6·4y	6·8	6·7	6·8	6·3y	6·7	
LSD	NS	NS	0·3***	NS	NS	NS	0·2***	NS	

Experiment 4				
1 Cooked without cleaning or trimming		6·9	6·5xy	6·6	
2 Carcasses trimmed before cooking		7·0	6·8x	6·8	
3 Cavity washed before cooking	NA	6·8	6·3y	6·4	NA
4 Carcasses trimmed and cavity washed		6·8	6·6xy	6·7	
LSD		NS	0·3*	NS	

[A]Hedonic scale 1 to 9: dislike extremely to like extremely.

[B]Degree of cooking scale 1 to 9: 5 is ideal.

NA, not assessed. LSD, least significant difference. NS, not significantly different and LSD omitted.

* Treatments significantly different ($P<0·05$); *** Treatments significantly different ($P<0·001$).

Any pair of treatments within a set and without a letter in common are significantly different ($P<0·05$).

Effect of thawing (experiments 2a and b)

In order to compare the eating quality of chickens that had been roasted from the frozen state with that of chickens that had been roasted after thawing, it was necessary to cook both lots of chickens to the same extent. In exploratory experiments, it was found that roasting frozen and thawed chickens to the same deep flesh temperature resulted in different degrees of cooking. The frozen chickens required longer roasting times than thawed chickens to reach a selected temperature and the surface of the frozen chickens was cooked to a greater extent than the surface of the thawed chickens. Therefore the frozen and thawed chickens were roasted until they appeared to the staff of the sensory laboratory to be cooked to the same degree. This judgment was then checked by asking the panelists to score the samples for degree of cooking on a nine-point scale; 1=overcooked,

5=ideally cooked, 9=undercooked (Table 2).

No differences were observed in colour or flavour between chickens roasted from the frozen state and those thawed before roasting. However, panelists considered that the size 9 chickens which were cooked from frozen for $2\frac{1}{2}$ h were slightly, but significantly, over-cooked ($P < 0.05$). The degree of cooking of the other experimental treatments was reported to be near ideal.

The most significant finding of experiments 2*a* and *b* is that thawing before roasting resulted in chickens of better texture. The data in Table 2 show that for chickens of both sizes the mean texture ratings of those that had been thawed before roasting are at least one point higher than those cooked from the frozen state. Tasters described the texture of the chickens roasted from the frozen state as *tougher* and *not as tender*. In addition, there was a significant ($P < 0{\cdot}05$) interaction in cooking method × anatomical part, which suggests that although the chicken carcasses were roasted intact, there may have been differences in the degree of cooking between the three anatomical portions, i.e. the leg, thigh and breast, which depended upon the cooking method. Panelists' responses also indicated that there was a greater variation in degree of cooking within birds roasted from the frozen state. In practical terms this means that chickens thawed before roasting are more likely to be cooked through evenly. Roasting chickens from the frozen state could result in well-done leg and breast portions, but undercooked thigh pieces, which, apart from reducing acceptability, may present a microbiological hazard.

Effect of thawing method (experiments 3a and b)

The eventual outcome of experiment 3 was that the sensory properties of a roast chicken appear not to be affected by the method used to thaw it. The investigation was repeated once, because on the first occasion a surprising and inexplicable result was obtained, and the replication was necessary to check its validity. In the first test the panel detected no significant differences in colour or texture between any of the samples, but they considered the flavour and general acceptability of chickens thawed unwrapped in air at 5°C for 24 h to be significantly inferior ($P < 0{\cdot}001$) to chickens thawed by all other methods, including thawing wrapped in air at 5°C for 24 h.

When the test was replicated no evidence of this effect was found; the panelists detected no significant differences in colour, flavour, texture or general acceptability between chickens thawed by the different methods, wrapped or unwrapped. Because the results for flavour and general acceptability for the first test were not reproduced and are also contrary to published information, they are discarded as spurious.

The only other effect worthy of comment was the observed preference for leg portions of chicken rather than breast or thigh pieces. This probably reflects a consumer preference for the drumstick and is independent of treatment effects within the experiment.

Effect of cleaning and trimming (experiment 4)

Frozen chickens as purchased by the consumer are generally considered to be sufficiently trimmed and cleaned to allow cooking without further preparation. However, some consumers trim much of the remaining fat and skin from the neck and anal regions and rinse the cavity with cold running water before roasting. Surprisingly, the results of the present tests show that for cooking in a rotisserie, the effect of these operations on the sensory quality of the chicken may not be trivial. The panel perceived no differences between treatments in flavour or general acceptability but found a significant difference in textural quality ($P < 0.05$). The texture of chickens which had been trimmed, but not washed, was preferred to that of chickens which had been washed but not trimmed; no explanation is apparent. Once again the leg portions were awarded significantly higher scores ($P < 0.01$) than other portions.

Recommendations

Based on these findings, certain preparative and roasting regimes can be suggested. However, it is important to distinguish between statistical and practical significance. The changes in sensory quality effected by the various preparative and roasting techniques in these experiments were not substantial, despite the fact that they were sometimes highly significant statistically. The mean scores in Table 2 indicate that, regardless of the experimental treatment used and the critical attitude assumed by the panel, all chickens were acceptable. *It should therefore be emphasized that the following*

recommendations are means of optimizing the sensory qualities, rather than procedures vitally necessary to ensure consumer acceptance:

- Wrapping in oven bags or aluminium foil results in the chicken being more tender but at the expense of not obtaining an attractively browned skin. However, removal of the wrapping for the last 30 min. cooking will allow partial browning.
- It is advisable to thaw frozen chickens before cooking to preclude toughening in texture and the possibility of some anatomical regions being undercooked and therefore being not only less acceptable, but also microbiologically hazardous.
- Because the method of thawing does not appear to affect sensory qualities, the main guideline to be observed is the prevention of microbiological contamination. Preferably, chickens should be cooked immediately after thawing, but if this is not convenient they may be kept below 5°C for up to 48 h.
- If chickens are cooked in a rotisserie it may well be worth while to trim the carcass, but extra washing is unnecessary and may result in toughening of the texture.

Acknowledgments

Thanks are due to the Australian Chicken Meat Federation and the N.S.W. Chicken Meat Council for supplying the chickens used in these experiments.

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Editorial notes

The editing and production of the *CSIRO Food Research Quarterly* are the responsibility of an Editorial Committee which is representative of the three laboratories of the Division of Food Research. This Committee has recently been reconstituted and now its members are Mr J. F. Kefford (Chairman), Mr I. R. McDonald (Secretary), Mr G. J. Walker (Divisional Editor), Mr G. Fisher (Technical Secretary and Consumer Liaison Officer), Miss Helen P. Dornom (DRL), Dr D. L. Ingles (FRL), and Mr S. C. Williams (MRL).

At this time the Division wishes to recognize the particular contribution of two of the retiring members of the Editorial Committee, Dr J. H. B. Christian who was a member for 25 years and Mr P. W. Board who has been Chairman for the last six years. There is ample evidence that *CSIRO Food Research Quarterly* is well respected as an extension and review publication within Australia and overseas and much of this high standing may be attributed to the loyal service of these two men.

Iodophor disinfectants — the need for care in use

Iodine is an essential element in human nutrition because it is a constituent of the hormones of the thyroid gland. The daily requirement is not well defined but is of the order of 150 μg/day for an adult. Deficiency of iodine in the diet may lead to enlargement of the thyroid gland, the condition known as simple goitre; but on the other hand excessive iodine intake may cause toxic goitre (thyrotoxicosis).

Endemic goitre was prevalent in Tasmania until the 1960s. Since 1966 however potassium iodide tablets have been distributed to schoolchildren, and potassium iodate has been added to bread at a rate of 2 mg/kg calculated to provide 100–150 μg of iodine per day to adults. These measures brought about virtual disappearance of endemic goitre, but at the same time a significant increase in the incidence of toxic goitre caused by excess intake of iodine occurred. A Thyroid Advisory Committee, set up by the Minister of Health in Tasmania, attributed the unexpected increase in iodine intake to the extensive usage of iodophor disinfectants in the dairy industry.

Accordingly the Thyroid Committee requested the Commonwealth Advisory Laboratory on Dairy Detergents and Sanitizers to investigate the effects of iodophor usage on iodine levels in milk and the possibility of reducing, by improved practices, the hazard of iodine overdosage. From that Laboratory, which is situated in the Dairy Research Centre of the N.S.W. Department of Agriculture at Richmond, N.S.W., has come a comprehensive report, *Iodophor Disinfectants in the Dairy Industry* (D. G. Dunsmore and A. M. Luckhurst, N.S.W. Department of Agriculture, 1975) which was presented to the National Health and Medical Research Council (NHMRC).

The report reveals that the average level of iodine (760 μg/l) in N.S.W. market milk in 1974 was the highest yet reported in world literature.* Only a small proportion (about 50 μg/l) was iodine naturally present in the milk; most of it came from iodophor contamination during handling of the milk on the farm. The high iodine contents were reflected in manufactured dairy foods, notably those made from whole milk.

Iodophors are detergent-disinfectants in which iodine, the microbicidal ingredient, is solubilized by a surface-active agent. Several common classes of iodophors are specified in the Australian Standard, AS 1398. Iodophors have become the most popular type of chemical disinfectants in the dairy industry, particularly on dairy farms, for a number of reasons. As they are coloured they are self-indicating as to concentration and surface residues, and also their acidity successfully 'cuts' milk stone deposits from equipment.

The investigations of Dunsmore and Luckhurst showed that iodine accumulation in milk, from the time it leaves the cow to the time it reaches the consumer, resulting from the use of iodophor disinfectants, amounted to 1024 μg/l under bad practice but only 205 μg/l under good practice. Good practice chiefly involved taking adequate measures in draining and rinsing vessels and equipment.

Iodophors are not at present widely used in the food industry outside the dairy industry. Nevertheless the NHMRC sees the need to warn the food industry generally of the importance of careful use of iodophors in order to avoid addition of iodine from this source to foods, and thus to remove the hazard to human health represented by inadvertent iodine overdosage.

J. F. Kefford

*As a result of a program of farmer education and regular testing of milk, this level is now well below the limit of 500 μg/l currently recommended by the NHMRC.

New cell for measuring the permeability of film materials

By E. G. Davis and J. N. Huntington

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Most packaged foods require some degree of protection against the uptake or loss of gases and vapours during distribution and storage. Consequently, in choosing a packaging material for a specific food it is necessary to take into account the permeability properties of the material. There is a continuing need, therefore, for data on the gas and vapour permeability of packaging materials in quality-control work and in research on the development of new materials. This article describes a new cell for measuring the permeability properties of flexible films.

The cell operates on the concentration-increase principle developed by Landrock and Proctor (1952) and therefore has advantages in simplicity and reliability over cells operating on other principles. The cell is used with a separate gas chromatograph (Fricke 1962; Karel *et al.* 1963) as the detection system instead of having built-in detectors. The use of a gas chromatograph permits a wide range of gases and vapours to be determined and it may be used for other laboratory applications; in contrast, built-in detectors are integral components of the permeability unit and are often expensive and specific for one gas or vapour. The new cell must be used in a temperature-controlled room or cabinet, but these facilities are available in most modern laboratories.

Description of the cell

The cell and its fittings are made from stainless steel and the clamping device from mild steel (Fig. 1). Each of the two cell compartments is fitted with a gas sampling port, two ball valves and a support for the film under test. Each support consists of concentric circles of wire fixed to four radial

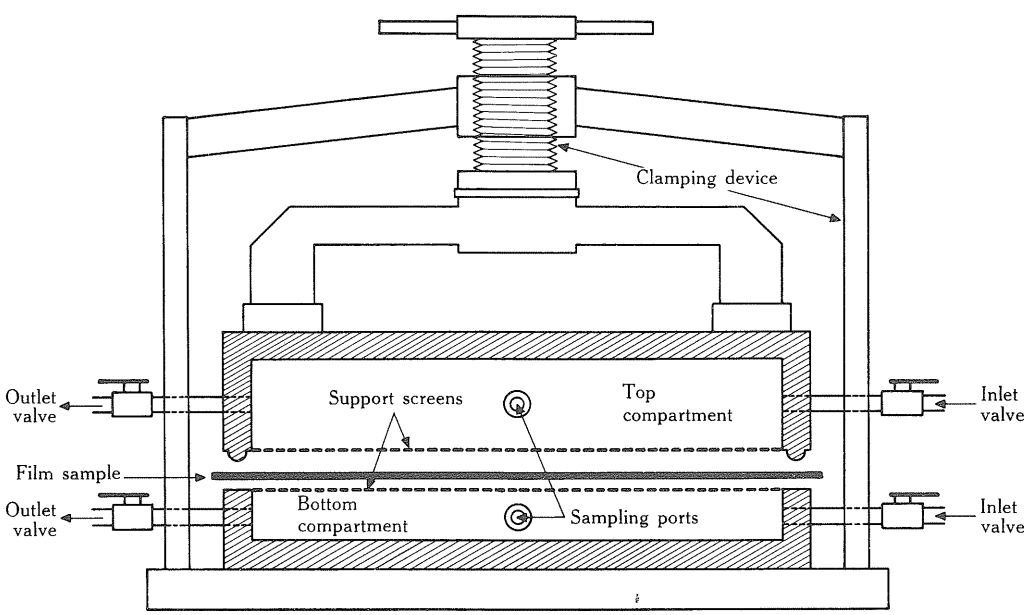

Fig. 1. Cross-section of the permeability cell and clamping device.

arms which are positioned inside the compartments in order to ensure that the sample of film remains flat. The sealing surface of the lower compartment is flat, whereas the other surface is rounded to a radius of 2 mm. Both surfaces are accurately machined and polished so that when a sample of film is clamped between the surfaces, the force from the clamping device is applied to a narrow circular area on both sides of the sample and gives an effective seal. The area of exposed sample is 0·02827 m^2.

The two compartments of the cell have volumes of about 1000 ml and 500 ml. Another component of the unit is a stainless steel disc which may be placed in the lower compartment to reduce its volume to *c.* 130 ml. The permeability of the sample to be measured determines which of the three volumes (1000, 500 or 130 ml) is used for the measuring compartment.

Figs 2 and 3 show the cell in operation, and disassembled, respectively.

Calibration

Calculation of the permeability of a sample of film from measurements made with the cell requires a knowledge of the internal volume of the measuring compartment. The volume of each compartment was determined by sealing a laminate of aluminium foil and polyethylene in the cell and flushing the compartments with nitrogen. The residual oxygen content of the nitrogen was measured by analysing samples of the atmosphere from the cell by gas chromatography. The inlet and outlet valves of the cell were then closed, and a known volume of nitrogen was withdrawn from each compartment and replaced by the same volume of oxygen. After an equilibration period of 1 h, the oxygen contents in the cell were redetermined. The volume (V) of each compartment was calculated from the relation:

$$V = (V_a \times 100)/(O_1 - O_0), \qquad (1)$$

where V_a is the volume of oxygen added and O_0 and O_1 are respectively the percentages of oxygen before and after the addition.

Operation procedure

With the film to be tested clamped between the compartments, one compartment is flushed with test gas and the measuring compartment is flushed with an inert gas such as nitrogen. The relative humidity of the gas streams may be controlled by placing desiccants or saturated salt solutions in the gas stream before the inlet cocks to the cell. The outlet lines are immersed to a depth of *c.* 2 cm in a beaker of water (Fig. 2), thereby avoiding back diffusion of air into the cell.

At a flow rate of 75 ml/min the cell may be flushed free of air in less than 30 min, but with hydrophilic films it is important to

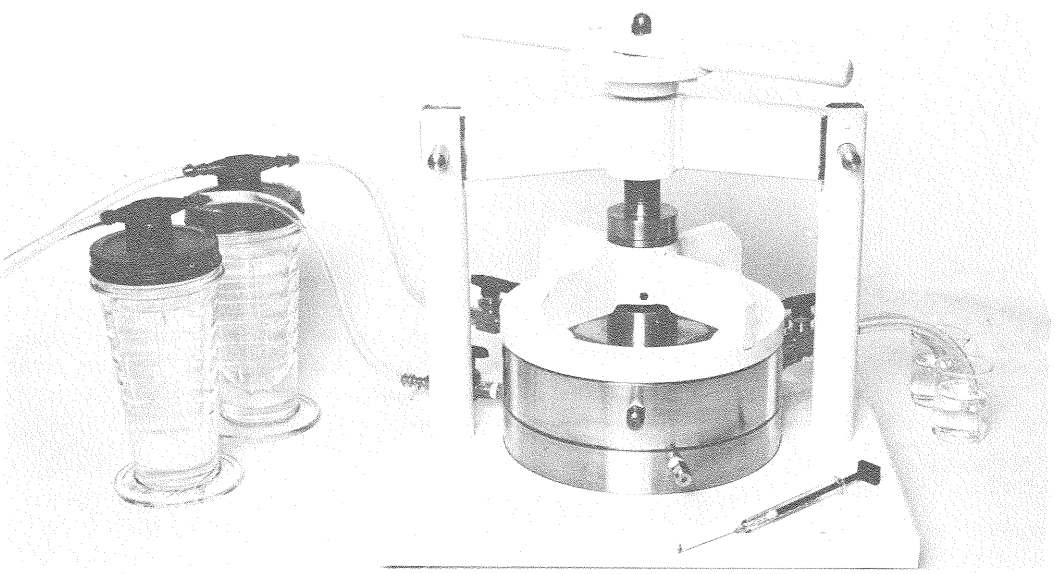

Fig. 2. The permeability cell being flushed with test gas.

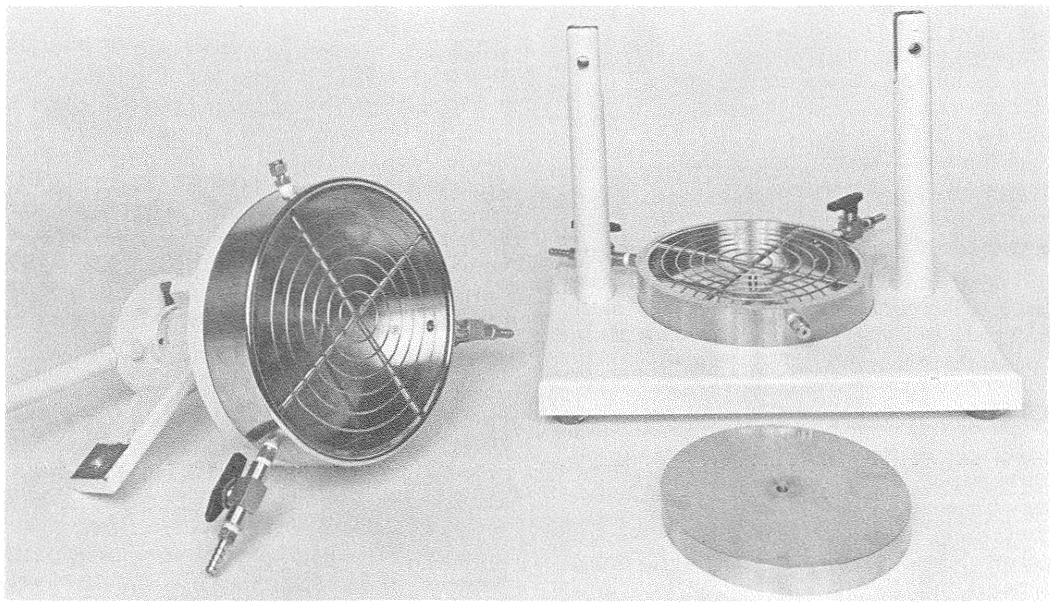

Fig. 3. Internal view of the cell.

continue the flushing operation until the film has reached equilibrium with respect to moisture content with the test conditions. The time taken to reach equilibrium can only be determined by repeating the determination of permeability on the same sample until constant results are obtained.

After the concentration of residual test gas in the measuring compartment has been measured, the gas flows from the supply cylinders are stopped and the inlet and outlet cocks of the cell are turned off, in that order. This procedure ensures that the pressure of the two gases in each compartment of the cell is equal. After a known time one or more samples of gas are withdrawn from the measuring compartment and the concentration of test gas is measured. The permeability of the film is calculated from the observed increase in the concentration of test gas in the measuring compartment.

Permeability calculation

The permeability (P) of a homogeneous polymer film to a gas may be defined by the relation

$$P = ql/At\Delta P, \qquad (2)$$

where q (ml) is the quantity of gas permeating through a film of thickness l (μm) and area A (m^2) in time t (h) with a partial pressure difference ΔP (kPa) across the film. Based on this relation, an equation may be derived to calculate the permeability of a film from observations made, using the concentration-pressure method.

Firstly, the quantity of gas, q (ml (STP)) is given by

$$q = \frac{V}{100}(G_1 - G_0)\frac{P_a}{101 \cdot 3} \times \frac{273}{T}, \qquad (3)$$

where V (ml) is the volume of the measuring compartment of the cell, G_0 and G_1 (%) are the initial and final concentrations of test gas in the measuring compartment, P_a (kPa) is the atmospheric pressure, and T (°K) is the test temperature.

For cases when $G_1 - G_0$ is small, i.e. less than say 1%, the mean partial pressure, ΔP in kPa of the test gas across the film sample is given by

$$\Delta P = \tfrac{1}{2}\left(\frac{P_aG_c - P_aG_0 + P_aG_c - P_aG_1}{100}\right), \qquad (4)$$

where G_c (%) is the concentration of the test gas supplied to the cell.

Simplifying (3) and (4) and substituting in equation (2) gives

$$P = \frac{5 \cdot 390\, Vl\,(G_1 - G_0)}{AtT\,(2G_c - G_1 - G_0)} \qquad (5)$$

in the units ml (STP) $\times$ μm $\times$ $m^{-2} \times h^{-1}$ $\times$ kPa^{-1}.

With heterogeneous materials, such as laminates and coated films, it is not valid to calculate the permeability for a unit

thickness, so the thickness term is omitted. The calculated value then becomes a transmission rate which is expressed in the units ml (STP) $\times$ m^{-2} $\times$ h^{-1} $\times$ kPa^{-1} together with a description of the composition of the test material.

Design features

The design of the cell incorporates several features which have important effects on the accuracy, versatility and convenience of operation of the unit.

Multiple measuring volumes

Ideally, equipment for measuring the gas permeability of flexible films should be capable of giving reliable results, in conveniently short test times, for films having permeabilities which differ by several orders of magnitude.

Examination of equation (5) shows that the test time is inversely proportional to permeability; hence, under specific conditions, the test time may be inconveniently long with low permeability films, or too short for accurate determinations with highly permeable materials. However, test time is also directly proportional to the two ratios $(G_1-G_0)/(2G_c-G_1-G_0)$ and V/A, and each of these ratios may be varied in the concentration-increase method to give some flexibility to the time required for a permeability measurement.

The first ratio is concerned with operating procedures, and it is clear that some control over test time may be achieved by varying G_1 or G_c. For instance, the test time for a low permeability film may be decreased by decreasing G_1 or increasing G_c. The lower limit for G_1 is governed by the sensitivity of the gas chromatograph employed, whereas the upper limit chosen should not reduce significantly the partial pressure of test gas across the sample. In the present work, the limits chosen for G_1 were in the range 0·1 to 1·0%. The upper limit for G_c is 100%, but it may be reduced by dilution with an inert gas for measurements on highly permeable materials.

The ratio V/A is associated with the cell design. In a cylindrical cell V/A is equal to the cell depth, so variations in cell diameter, or sample area, have no effect on test time if the cell depth remains constant. The present cell accommodates a film of fixed area, but provides three compartments with volumes in the approximate ratio 1:3·7:8·4.

Fig. 4 shows the calculated test times for specified increases in test-gas concentration in the three sizes of cell as a function of the gas transmission rate of the sample. Thus, transmission rates within the range $3\cdot0\times10^{-3}$ to 7·5 ml (STP) $\times$ m^{-2} $\times$ h^{-1} $\times$ kPa^{-1} may be measured within 1–24 h. Films having lower transmission rates would require longer test times, such as over a weekend, whereas those having higher rates may be measured with test-gas concentrations of less than 100%.

Film supports

Gas permeability cells which do not depend on a difference in absolute pressure across the sample require no mechanical support for the film. However, uncontrolled movement of the sample, resulting from small pressure differences in the two compartments of the cell, or from sagging of the sample, will affect the volume of the measuring compartment and introduce errors.

The decrease in volume V (ml) of a cell compartment of diameter d (cm) owing to movement of a sample by distance h (cm)

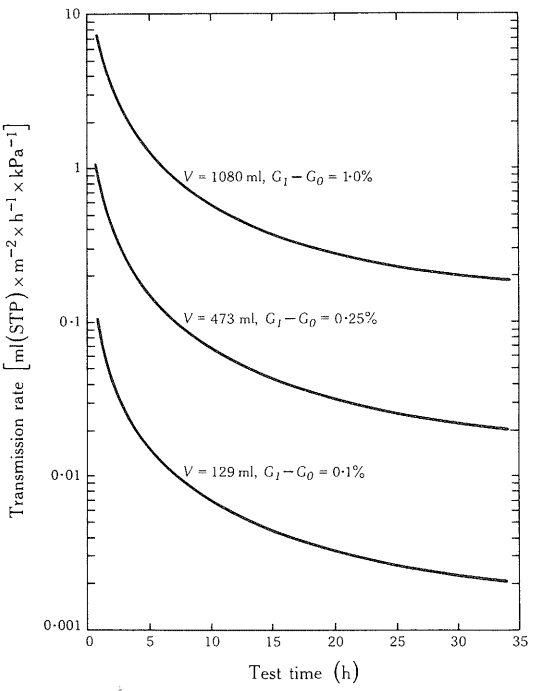

Fig. 4. Calculated test times for various transmission rates of test films; choice of measuring compartment may be made from these parameters.

at its centre is given by

$$V = 1/6\ \pi h\ (3\ d^2 + h^2) \qquad (6)$$

Thus, if the sample is distorted by 0·2 cm in the small cell compartment of 130 ml, the effective volume will be reduced to 113 ml and the measured permeability value will be higher by 15%. The use of wire supports on either side of the sample reduces such errors with negligible interference to the diffusion of gases at the sample surfaces.

Sealing mechanism

Most gas permeability cells rely on some type of sealing aid such as gaskets, O-rings, grease, or mercury, to avoid leaks. Although concentration-increase cells are less susceptible to leakage than those that rely on a difference in total pressure, reliable seals are important, particularly for measurements on samples having a low permeability.

The sealing mechanism used in the present cell has been found to be satisfactory with a wide range of flexible film materials. The absence of a gasket avoids the problem of sorption of the gas or vapour to be measured and this advantage is of particular importance in studies involving organic vapours. However, two types of material have been encountered, viz. polyethylene terephthalate and polystyrene, which cannot be sealed satisfactorily. Suitable seals with these hard materials may be obtained with the aid of a gasket of 50 μm polyethylene between the sample and the sealing surface of the measuring compartment. Seal efficiency with specific samples may be tested by filling both compartments with oxygen and at intervals examining the atmosphere in the cell for leakage of nitrogen from the air.

Performance of the cell

Both the accuracy and precision of results obtained with a new type of permeability apparatus are important in assessing the performance of the equipment. Whilst precision is easily measured by making repeat determinations on the same sample, accuracy is difficult to measure because there are no standard permeabilities recognized for polymer films. Comparison of data from the literature is not reliable because of differences in the test samples, equipment, and operational procedures. Karel *et al.* (1963), for instance, showed that a coefficient of variation of the order of 5–15% may be expected among different samples of the same type of film material, but repeat measurements on the same sample gave a coefficient of variation of $< 5\%$.

Two materials, low-density polyethylene and a laminate of PVDC/polyamide/polyethylene, were chosen for measuring the precision of the cell. These materials were selected because their oxygen permeabilities approach the upper and lower limits likely to be encountered with flexible films used commercially. Ten repeat estimations of oxygen permeability at 25°C and 75% R.H. were made on one sample of each material. The analyses were made by means of a Fisher Gas Partitioner (Model 25V)* and a 1-ml Hamilton† gas-tight syringe. The following mean values and coefficients of variation were obtained.

Polyethylene (50 μm) $1 \cdot 40 \pm 1 \cdot 5\%$ ml (STP) $\times$ m^{-2} $\times$ h^{-1} $\times$ kPa^{-1}

PVDC/polyamide/polyethylene $4 \cdot 55 \times 10^{-3} \pm 3 \cdot 9\%$ ml (STP) $\times$ m^{-2} $\times$ h^{-1} $\times$ kPa^{-1}.

These results show that the precision of the method is satisfactory, and that its variability should be less than that which can be attributed to inherent variation among different samples of commercial films.

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*Fisher Scientific Co., Pittsburg, U.S.A.

†Hamilton Co., Reno, U.S.A.

Postharvest handling and diseases of rockmelons

By S. C. Morris

N.S.W. Department of Agriculture, Gosford Horticultural Postharvest Research Laboratory, Gosford.

The plant we know in Australia as rockmelon (*Cucumis melo* L. var. *reticulatus* Naud.) is identified by different names overseas. It can be described as a muskmelon, a general name for the species which also includes other sweet melon cultivars such as Honey Dew, Persian and Casaba. Throughout the world rockmelons are generally called 'cantaloupes'. Other closely related members of the cucurbit or melon family are watermelons, cucumbers and gherkins (Whitaker and Davis 1962).

Historically, rockmelons are a recent crop, having been grown commercially for less than 100 years, and in Australia they have moved from the backyard to commercial agriculture more recently still. Melons are grown on a large scale in America and most research has been done there. The research arose from the need to ship melons over the long distances from the major production centres in the western and southern states to the large markets in eastern America.

In Australia most rockmelons are grown within a day's journey of the market. This means that melons may be on sale to consumers 2–4 days after harvest, instead of 8–12 days, which is common in the United States. Owing to the shorter time required for marketing and the smaller scale of crop production in Australia than in America, the fruit has been given little postharvest care here. However, increased crop production and the demands of more discerning consumers have focussed attention on two of the main problems affecting the rockmelon industry in Australia: the marketing of immature fruit and excessive losses during marketing caused by fungal breakdown (Morris 1976). In order to supply the market with high quality rockmelons at competitive prices, thus increasing sales, the Australian industry must apply the latest findings from commercial practice and from research that has been adapted to local conditions.

Handling and storage

Maturity

Unlike other fruits, a rockmelon is fully mature when an abscission layer forms which enables the melon to be pulled from the vine leaving no adhering stem tissue. Melons which have reached this stage (called 'full-slip') have a superior flavour since most of the sweetness of rockmelons develops in the last few days before abscission. Full-slip as an indicator of maturity for picking is a well researched and widely used overseas method of ensuring that only mature melons are harvested (Davis *et al.* 1953, Ogle and Christopher 1957; Seeling 1973).

Marketing of immature melons has in the past caused considerable problems in the United States, where laws now specify a minimum solids content (which is highest in mature melons) to prevent melons less mature than full-slip from being sold (Davis *et al.* 1953).

Rockmelons are an unusual fruit as they have no reserve starch which can be converted to sugars after harvest. As most of their sweetness and flavour accumulates in the few days before maturity (as shown in the figure), it is essential to harvest only mature melons to ensure the best possible flavour. Immature melons consequently have a decidedly inferior flavour as they cannot become sweet after harvesting, even though they soften and turn yellow normally.

In Australia it is common practice for melons to be cut from the vine rather than pulled at full-slip. This harvesting method, in the light of what is known about the maturation of melons, must result in a much greater number of immature melons being harvested.

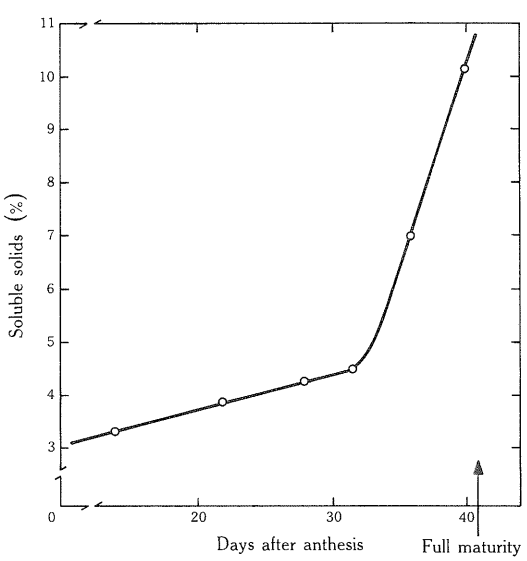
Harvesting

Temperature at harvest, timing of the growing season and weather preceding

harvest, have all been found to affect the quality of melons. Melons harvested in hot weather break down more rapidly than those harvested in cooler weather; also late-season melons are more susceptible to fungal attack than early-season melons (Lipton and Stewart 1961). Finally, warm dry weather before harvest results in better eating quality (Yamaguchi and Hughes 1975).

The implications of these results are that melons should be harvested during the cooler parts of the day and that every effort should be made to prevent heating during and after harvesting (e.g. trailers of melons should be kept in the shade). They should be moved as soon as possible to the packing shed and special care is needed if late-season melons are to be grown successfully (careful handling, treatment and cool storage). The observation that warm, dry weather results in better eating quality explains why some districts produce better melons than others.

While careful handling of melons is important at all stages of marketing, it is especially important in the field because damage to the skin or net allows the entry of pathogenic fungi. These organisms usually invade only through injury points and if infection starts at these points, it may be well advanced by the time the melon reaches the consumer. Dropping or tossing the melon greatly increases damage. Therefore handling practices and equipment should be designed to eliminate dropping the fruit and contact with rough surfaces.



Changes in soluble solids as rockmelons (PMR 45 type) mature on the vine: after Pratt et al. (1975).

Packing

As soon as possible after harvest, melons should be moved to the packing shed. In American packing sheds melons are subjected to the following procedures (Seeling 1973).

Firstly, diseased, overripe, or damaged melons are culled, they are then rinsed, dipped in a fungicide and coated with wax. Next the melons are graded (with care not to damage the net), packed, and finally cooled.

Commonly the fungicides sodium orthophenylphenate (SOPP) and sodium dimethyldithiocarbamate (SDMC) are applied in wax at 1–2% rather than as a separate dip (Stewart 1976). However, recent research has shown that this common commercial treatment can be considerably improved. Stewart (1970; 1973) compared several fungicide dips with the commercial fungicide-wax treatment and found that the dips gave better control of fungal breakdown. The fungicides used were Captan (300–3250 mg/l), Maneb (360–3250 mg/l) and SDMC (2500 mg/l). Control of fungal rots has also been achieved with thiabendazole (TBZ) at 250 mg/l and sodium hypochlorite at 750–2000 mg/l (Wells and Stewart 1968).

Hot water dips (55–60°C) are another potentially useful treatment and they have been shown to be as effective, if not more so, than fungicides (Johnson 1968; McDonald and Buford 1971; Wells and Stewart 1968).

The temperature and duration of the dip is important, as temperatures >62°C, or dipping for longer than 60 s at the recommended temperatures, may cause unattractive browning of the vein tracts. Optimum control has been achieved with a combined treatment of hot water and fungicides, but the extra improvement obtained by adding fungicides may not be economical (Stewart 1970; Stewart and Wells 1970). Hot water may be applied by immersing or flooding the melons; both methods have been shown to be equally effective (Stewart 1973).

After the fungicide or hot water treatment, melons should be graded for size and maturity so that even packing is possible. When packed, the fit should be firm enough to prevent movement during transport but not so tight (as in vigorous bulge packing) that crushing or splitting occurs.

Probably the most important factor in marketing high quality melons is rapid

cooling. As soon as possible after the melons leave the packing line they should be cooled to remove field heat, which can be considerable during the height of summer. Unless this is done fungi will grow vigorously for a considerable period in the warm fruit.

There are three main cooling methods. Hydrocooling, the most frequent method used, takes 30–45 min to cool melons to the best storage temperature of 4–5°C. Forced air cooling takes up to 6 h, and room cooling about 24 h (Seeling 1973; Stewart 1976). Forced air cooling is increasing in popularity since the cooling time is not excessive, the capacity of the cooling system is normally not limited, and the method does not wet the fruit as in hydrocooling. Where hydrocooling is used it has been found that the addition of sodium or calcium hypochlorite to the cooling water can improve the keeping life of melons significantly (Lipton and Stewart 1961).

Marketing

Research in the U.S.A. has shown that at ambient temperatures the marketable life of a full-slip melon is 2–6 days, while that of a half-slip melon is 4–8 days (Gilbart and Dedolph 1964). From our own experiments these times also apply in Australia. Holding melons at 4–5°C increases the marketable life of a full-slip melon to 14 days or longer (Ogle and Christopher 1957); however, storage at lower temperatures than this may cause damage to the melons (Wiant 1938).

Melons in transit to terminal markets should not be allowed to warm. For this reason they should be transported in refrigerated, or at least in insulated vehicles when travelling time is < 12 h. When it is necessary to store melons before sale the fruit should be held in cool rooms at 4–5°C. Storage at these temperatures helps to maintain quality and prevents the rapid growth of most rockmelon diseases which are possible under ambient conditions. However, even with cool storage, melons should be sold as soon as possible to minimize loss of quality.

Correctly harvested and marketed melons may still need 1–2 days to ripen fully. A fully ripened melon can be recognized by a springy feel under soft pressure, a strong distinct aroma and a yellowish background skin colour. If the melon is eaten before it has softened and ripened sufficiently the consumer will be deprived of its full flavour as a dessert fruit.

Postharvest diseases

Although a considerable amount of work has been done to reduce losses of rockmelons caused by fungal rots, few workers have looked in detail at specific organisms involved, or at the methods required for specific control of these organisms. The main diseases reported for rockmelons are: Fusarium Rot, Rhizopus Soft Rot, Alternaria Rot, and Cladosporium Rot (Friedman 1956; Ramsey and Smith 1961; Seeling 1973; Wiant 1937). At normal room temperatures the first two rots mentioned are the most serious, but in cool storage these rots are less important and Alternaria and Cladosporium Rots are more significant. Blue Mould Rot (*Penicillium* spp.) (Ramsey and Smith 1961), and *Geotrichum candidum* (Seeling 1973) occasionally may cause significant losses.

Fusarium Rot

Up to eight different species of *Fusarium* have been associated with this rot (Ramsey and Smith 1961; Wiant 1937; Wells and Stewart 1968). Externally, main symptoms are tufts of white or reddish hyphae showing through the net, while internally the organism develops light-coloured, shallow, spongy lesions which can be readily removed from the flesh.

Good control of Fusarium Rot has been reported with TBZ (250 mg/l), Manzate (3250 mg/l) and Captan (3250 mg/l), while moderate control was obtained with hot water (57°C, 30 s), Chlorine (750 mg/l) and Ziram at 3250 mg/l (Wells and Stewart 1968). *Fusarium* spp. were found to be susceptible to nitrogen chloride fumigation using 0·53–1·17 g NCl_3/m^3 for 5 h (Barger *et al.* 1948). Stewart and Wells (1970) treated rockmelons showing symptoms of attack by *Fusarium*, *Alternaria* and *Rhizopus* with Captan (300 and 600 mg/l) and hot water (57°C) dips. Both treatments gave control when used separately, but the best control was obtained when the two treatments were combined.

Rhizopus Soft Rot

Although this disease is of major importance its causal organism (or organisms) has not been well-defined. It is usually assumed that the main organism is *R. stolonifer* (Fr.) Ehr. (Ramsey and Smith

1961; Wiant 1937), but inoculation work by Harter and Weimer (1922) suggests that several species of *Rhizopus* may cause this rot. The main symptoms are a general softening and indentation of large areas of flesh with little external mycelial growth. Internally the lesions are soft, wet and pliable and can be separated from healthy tissue, since the lesions are held together by mycelia.

There have been no reports of specific control measures for Rhizopus Soft Rot, but Lipton and Stewart (1961) observed that hydrocooling, SOPP (1000 mg/l) and calcium hypochlorite (200 mg/l) had no effect on Rhizopus Soft Rot either individually or as combined treatments. Control of fungal rots on rockmelons has been reported in a trial where *Fusarium* and *Alternaria* symptoms were present as well as those for *Rhizopus* (see Fusarium Rot). *Rhizopus* spp. have been found highly resistant to NCl_3 fumigation (Barger *et al.* 1948).

Alternaria Rot

The actual organism (or organisms) involved has not been well characterized. The main organism is probably *A. tenuis* Nees. but several other species could be involved (Ramsey and Smith 1961; Wiant 1937). The main symptoms are dark brown to black lesions which may coalesce and which are usually covered with a thin layer of dark sporulating hyphae. Internally the lesions are dark brown to black in colour, shallow and sharply delineated from healthy tissue.

There have been no specific attempts to control Alternaria Rot, but Lipton and Stewart (1961) found that together with Cladosporium Rot it was reduced by calcium hypochlorite (200 mg/l) and SOPP (1000 mg/l). Nitrogen trichloride fumigation only partially controlled *Alternaria* spp. (Barger *et al.* 1948), while control of fungal rots which included *Alternaria* symptoms has been reported (see Fusarium Rot).

Cladosporium Rot

The main organism responsible seems to be *Cladosporium cucumerinum* Ell. x Arth. (Ramsey and Smith 1961; Stewart and Wells 1970; Wiant 1937). It is more prevalent in cool-stored melons and mainly occurs around the stem scar (Wells and Stewart 1968). Symptoms include very shallow lesions, 2–4 mm in depth. They vary in colour from dark green or black at the surface to flesh colour at the inner edge and the lesions are sharply delineated from healthy flesh.

No specific work on the control of this rot has been reported except the finding by Barger *et al.* (1948) of only intermediate susceptibility to NCl_3 fumigation. Control of fungal rots which included *Cladosporium* has been reported (see Alternaria Rot).

Australian situation

The principal rots found in Australia differ significantly from those reported overseas. While *Fusarium*, *Cladosporium* and *Alternaria* spp. have often been found, two rots of importance under Australian conditions have been scarcely mentioned in previous literature. These two pathogens are *Geotrichum candidum* (a fungus which attacks a diverse range of plants) and *Mucor* spp. which causes a rot similar in some ways to Rhizopus Rot.

Conclusion

Rockmelons are a crop with considerable potential in Australia and production has increased markedly in recent years. This expansion has meant that the often minimal postharvest care given to rockmelons is no longer adequate. Indeed, the high wastage during marketing and unfavourable consumer reaction to unripe or excessively blemished melons suggests that considerable changes are called for.

The quality of rockmelons available to the consumer could be greatly improved if better practices were adopted by the industry, beginning with harvesting procedures and continuing through postharvest fungicidal treatments, cooling, packing and retail handling. Harvesting melons at full-slip can increase susceptibility to rots and the need for careful handling and postharvest protective treatments. These treatments will increase costs but should be more than offset by the reduced losses and increased demands.

Recent research has revealed differences in the types and relative importance of fungal pathogens found on Australian rockmelons compared with those reported in overseas work. This research, conducted over the last two seasons, has shown that effective protective treatments can be developed which will enable rockmelons of truly high quality, both in appearance and flavour, to be marketed.

Acknowledgments

I would like to thank Dr N. L. Wade (N.S.W. Department of Agriculture), located at CSIRO Division of Food Research, North Ryde, who has been involved in the investigations referred to in this review and Professor H. K. Pratt, Department of Vegetable Crops, University of California, for permission to use the figure.

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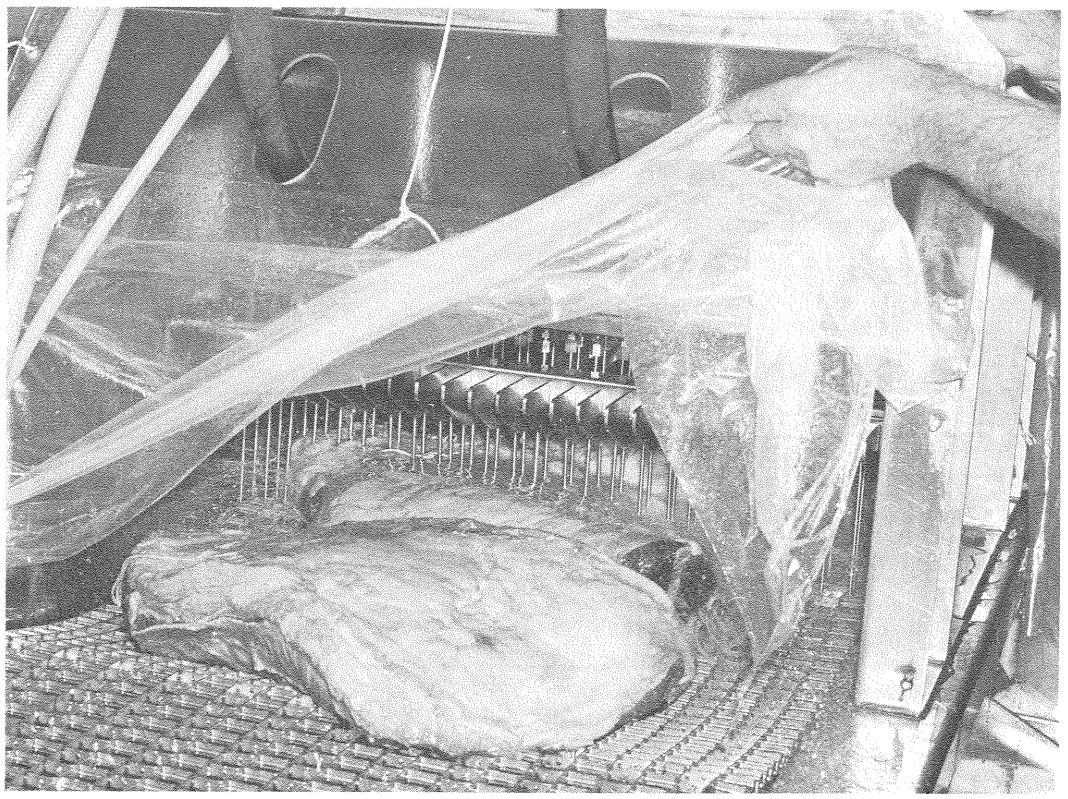
Boneless cured brisket beef for export

When prices for beef are depressed some parts of the carcass, the brisket, for instance, may have a low value in traditional local and export markets. At those times the cheap cuts are often sent to the rendering operation rather than being processed for human consumption. A relatively inexpensive process has now been developed at the CSIRO Meat Research Laboratory at Cannon Hill which could allow this low-value meat to be sold to new markets, including those in developing countries.

The long-established process of preserving meat by salting and curing was adapted for the preservation of brisket beef for export as a non-refrigerated, uncooked product. A saturated brine containing nitrite, nitrate, phosphates, citrate and erythorbate was pumped into the boneless brisket with multineedle injection equipment. The briskets were then placed in plastic bags with sufficient brine and dry salt to ensure that pathogenic bacteria could not grow. The bags were then evacuated, sealed and held at 5°C for several days until the salt diffused into all parts of the brisket in sufficient quantities to make the product stable at ordinary temperatures.

In a typical operation boneless brisket was pumped to a 20% increase in weight with a saturated brine containing 1225 ppm sodium nitrite, 6250 ppm sodium nitrate and the other ingredients mentioned above. The briskets were then quartered and individual pieces were packed into flexible film bags with 170 g of the pumping brine and 170 g



Pumping the curing brine into brisket cuts.

dry salt per kg initial raw weight of brisket. The best results were obtained with bags which had a low permeability to oxygen and which were resistant to perforation by the crystalline salt. After the evacuated, sealed bags had been held at 5°C for 7 days the mean concentration of salt in the meat was about 16% and it was then possible to store the product at ambient temperature. After about 8 weeks the meat became almost saturated with salt, and nitrate and nitrite concentrations had decreased to acceptable levels.

Brisket beef processed in this way retains its acceptable qualities for several months when stored at room temperature and trial shipments to overseas markets have been well received. Further details of this process are available from the Industry Section of MRL.

IAN EUSTACE

Apricot breakdown

In an earlier *Quarterly* (1975, **35**, 56–57) we summarized Californian investigations of texture breakdown in canned apricots which confirmed Australian findings that breakdown of the fruit tissues was caused by pectolytic enzymes which were produced by the fruit-rotting fungus *Rhizopus stolonifer* and which survived heat processing of the canned fruit.

Californian workers subsequently looked for ways of destroying fungal enzymes, before processing, by surface chemical treatment of the apricots. The most promising treatments were dips in cold sodium hydroxide solutions (0.5–1.0 N) for 0.5 to 2 min. More severe treatments tended to remove skin from the fruits. Commercial treatments envisaged to rupture fungal lesions and destroy the pectolytic enzymes are a vigorous water-spray wash followed by a dip or spray of lye, or a jet spray of lye alone and then thorough rinsing of the treated fruit.

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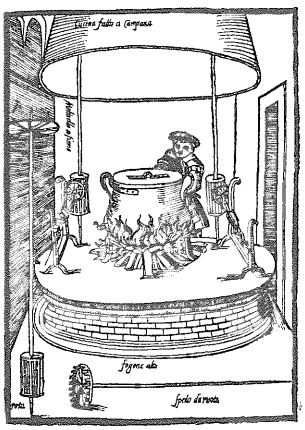
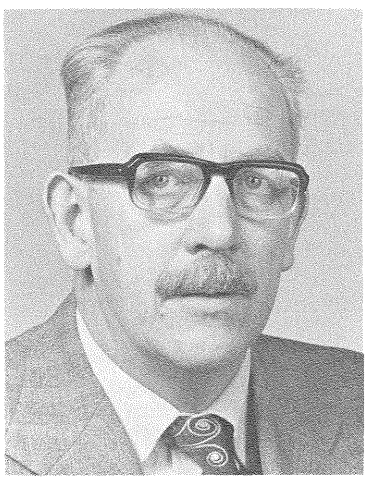


News from the Division

Officer-in-Charge FRL

Dr Alan R. Johnson, who has been acting as Officer-in-Charge of the CSIRO Food Research Laboratory since early in 1977, has now been confirmed in that appointment.

Dr Johnson graduated with Honours in Biochemistry at the University of Leeds and then completed his Ph.D. at the same university on studies involving the chemical activities of certain microorganisms. He took up a lectureship in Biochemistry at the University of Adelaide and subsequently accepted the position of Project Leader of the Commonwealth Anti-oxidant Research Project in the Physiology Department there. His work concerned possible hazards in the use of food grade anti-oxidants. On the closure of the Anti-oxidant Research Project, Dr Johnson spent some time working with Dr F. B. Shorland in the Fats Research Laboratory of the DSIR in New Zealand. In 1961, he returned to Australia to join the CSIRO Division of Food Research and for several years was Leader of the Biochemistry Section. His work has covered many areas of food science, including the metabolism of the cyclopropene fatty acids, the role of biotin in the fatty liver and kidney syndrome, and the oxidative stability of milk rich in polyunsaturated fatty acids. Dr Johnson played a leading role in coordinating the work in CSIRO with industry and overseas research organizations on the production of ruminant foodstuffs containing increased amounts of polyunsaturated fatty acids. In connection with various aspects of his work, Dr Johnson has made several visits overseas including acceptance of invitations to spend a year as a visiting scientist at the Unilever Research Laboratories, Colworth House, and more recently, with Professor A. S. Truswell in the Department of Food Science and Nutrition, Queen Elizabeth College, London.



Assistant Chief (External Relations)

In March 1977 Mr J. F. Kefford, formerly Officer-in-Charge FRL, joined the Head-quarters Group as Assistant Chief (External Relations) to take charge of some aspects of the external relations of the Division. He has responsibilities particularly for the relations of FRL with industry, government departments and some international bodies. Mr G. Fisher has also joined the Head-quarters Group and is assisting Mr Kefford in these duties.

Secondment

In December 1976 Dr N. S. Scott of the Plant Physiology Unit (FRL) was seconded to the Division of Horticultural Research, CSIRO, Glen Osmond, S.A., for an initial period of two years.

Appointments

Mr R. F. Adams has been appointed as Senior Research Scientist in FRL's Micro-biology Section to head a new research project on the microflora of the human gut. Mr Adams has had wide experience in this field in England, the U.S. and Australia.

Mr D. S. Macarthur, Research Scientist, has joined the Process Development Group (MRL) to investigate new process techniques. He was awarded an honours degree in engineering at Churchill College, University of Cambridge and before joining CSIRO he worked for Rolls-Royce's Aero Engine Division.

Mr D. T. Kerr, Experimental Officer, has joined the Process Development Group (MRL) to assist in investigations of new process techniques. He was awarded a diploma in mechanical engineering by Caulfield Technical College and worked for M.W.M. Diesel (Far East) Pty Ltd before joining CSIRO.

Miss L. Small, Experimental Officer, has joined the Biochemistry Section (MRL) to assist in studies of muscle biochemistry. She gained an honours degree in parasitology from the University of Queensland in 1976.

Dr B. V. Kavanagh, Research Scientist, has joined the Process Investigation Section (MRL) to study the disposal of sludges from abattoir waste treatment plants. He was awarded his Ph.D. in soil science and plant nutrition by the University of Western Australia in 1975. Dr Kavanagh was a research fellow in soil science at the Waite Agricultural Research Institute, South Australia, before he joined CSIRO.

Mr S. Moodie, Experimental Officer, has joined the Process Investigation Section (MRL) to assist in studies of sludge disposal. He was awarded an honours degree in Chemical Engineering at the University of Melbourne in 1970. Before joining CSIRO he worked as a research officer in the Department of Chemical Engineering at the University of Queensland.

Visiting workers

Dr D. Georg, Institute of Food Technology and Packaging, Technical University of Munich, West Germany, is spending a year at FRL under an Australian/European Awards Program.

Professor D. V. Vadehra, Microbiology Department, Panjab University, Chandigarh, India, has returned to FRL to complete his studies on changes in egg yolk after the growth and metabolism of several bacteria.

Congress

The University of Sydney will host the XXth International Horticultural Congress, the first to be held in Australia, from 15 to 23 August 1978.

The Organizing Committee has formally called for papers and registration of delegates. The last date for receipt of papers is 1 February, and for registration 1 April 1978. An additional fee is charged for late registrations. There is no restriction on who may attend the Congress, but registration is on a full-time basis only and costs $80 for delegates, $40 for students, or $25 for persons accompanying delegates. At least 1500 delegates are expected to attend, the majority coming from overseas.

The formal program is divided into eight sections running concurrently: Interdisciplinary, Postharvest horticulture, Citrus, Viticulture, Temperate fruits, Subtropical and tropical fruits, Vegetables, and Ornamental and amenity horticulture.

The Food Research Laboratory of the CSIRO Division of Food Research is actively involved in the organization of this Congress. In addition to technical contributions to the program, the Division, in conjunction with the N.S.W. Department of Agriculture, will stage a half-day exhibition on Australian postharvest horticultural research during the Congress. Dr W. B. McGlasson of FRL is a member of the Congress Organizing Committee, and Chairman of the Congress Program and Postharvest horticulture subcommittees, and Dr B. V. Chandler is a member of the Citrus subcommittee.

Full details of the Congress are available from: The Secretary, XXth International Horticultural Congress, 157 Liverpool Street, Sydney, N.S.W. 2000.

Overseas travel

Mr L. L. Muller (DRL), during a private visit to the U.S.A. and Europe, presented a paper entitled 'The future of milk proteins' to the International Dairy Federation Seminar on New Dairy Foods, held in Killarney, Ireland, during April 1977.

Dr B. S. Harrap, Messrs R. Beeby, F. G. Kieseker, L. L. Muller, Miss Helen Dornom of DRL and Professor W. J. Harper, Visiting Scientist, visited New Zealand in mid-March to participate in the international conference held to celebrate the Golden Jubilee of the New Zealand Dairy Research Institute.

Dr J. H. B. Christian, Associate Chief, participated in the 2nd Joint FAO/WHO Expert Consultation on Microbiological Specifications for Foods, held in Geneva in February 1977, and subsequently attended the XII General Meeting of the International Commission on Microbiological Specifications for Foods, held in Cairo, in March.

Dr D. G. Bishop (Plant Physiology Unit, FRL) is spending 15 months at the University

of Utrecht and visiting research centres in Europe, Britain and the U.S.A.

Dr D. J. Casimir (Food Technology Section, FRL) presented a paper on the Australian reversing spin flame sterilizer at the First International Congress on Engineering and Food in Boston in August 1976, and visited research organizations and companies in the U.S.A. and Europe interested in flame sterilization. He also spent six weeks working with Professors F. Emch and H. R. Lüthi at the Swiss Technical University, Zurich on the counter-current extraction of apple juice.

Mr K. J. Scott has recently made several visits to New Zealand to work on postharvest calcium treatment of apples for the N.Z. Apple and Pear Board. Similar cooperative studies are underway in Australia with collaboration from the State Departments of Agriculture of Western Australia, Victoria, South Australia and Tasmania.

Dr B. V. Chandler (FRL) receives the 1977 Award of Merit of the Australian Institute of Food Science and Technology from the President, Mr F. M. Bird, at the AIFST Convention 26 May 1977.

Consumer liaison

At the time of Australian Fish Expo '76 (FRQ **36**, 2) the Division published four consumer leaflets on seafoods:

- Seafoods — hints on buying, home freezing and preparation.
- Fish — from Australian waters.
- Australian Crustaceans — lobsters, crabs and fresh water crayfish.
- Australian Molluscs — oysters, scallops, mussels and pipis, abalone, squid, octopus and cuttlefish.

Another consumer leaflet — 'Storage Life of Foods' dealing with frozen, canned and dehydrated foods is now available for distribution. Additional titles will be published from time to time.

Retirement

Douglas F. Ohye

Douglas Ohye, longest-serving member of the Division, has taken long-service leave prior to retirement on 9 January 1978. He began his career with CSIRO in May 1934 when, at the age of sixteen, he was appointed as a Junior Laboratory Assistant at the Cannon Hill Laboratory of the Section of Food Preservation. The laboratory then had a staff of three scientists (W. A. Empey, W. J. Scott and J. R. Vickery) and one assistant (Henry MacDonald). Another scientist (A. R. Riddle) was appointed soon afterwards and naturally both assistants were very fully occupied in all aspects of the work on the preparation and storage of beef.

Doug's initial salary was $138 per annum, rising to $162 after his seventeenth birthday. His first responsibility was the preparation of bacteriological media. During the next four years he completed the Diploma in Industrial Chemistry, a part-time course at the Brisbane Technical College. After two more years at Brisbane he was transferred to the new headquarters of the Division at Homebush.

His first year at Homebush was spent with J. F. Kefford who was making a study of the effects of ozone on the growth of micro-organisms on meat. The microbiological work was carried out by Doug. Later he joined the Microbiology Section, initially as an assistant to Scott and later as a laboratory manager for the group which expanded rapidly during the war years. Several new

appointments were made, and Doug trained all the juniors and kept the laboratory supplied with large quantities of sterile equipment and media needed for coping with the avalanche of canned, bottled and dried foods being examined.

In those days there were very few items of scientific equipment made in Australia, and there were great difficulties and delays in obtaining imports. Necessity again mothered invention, and Doug became a skilled glass worker combining this with a knowledge of simple electronic circuits to make, entirely by hand, dozens of very useful items including glass electrode assemblies and all-glass water stills with automatic controls.

Promotion from Technical Officer Grade 2 was fairly rapid for Doug, but a number of years were to elapse before the staff section agreed that any shortcomings in the Brisbane Diploma course could no longer debar Doug from well merited advancement to the professional ranks. During the next 20 years Doug Ohye continued to grow in scientific stature and to acquire additional technical skills. For many years he served on a Standards Association Committee concerned with standards for laboratory glassware. He became knowledgeable about vacuum technology and made several laboratory freeze-driers which were an essential part of the laboratory's work on the drying of microorganisms. In the latter stages of his career Doug has established himself as a first-class electron microscopist who, along with W. G. Murrell and others, has contributed substantially to scientific knowledge of bacterial spores.

Many senior colleagues will always be indebted to Doug for his sustained diligence, cooperation and loyalty, and none more than the author of this note. Others will remember his generosity whenever his advice or assistance was sought. All will miss a modest and unassuming friend.

Away from the laboratory Doug devoted most of his time to his family. He built three houses, established and sold an orchard, and has embarked on pre-retirement leave in his latest home overlooking the Pacific Ocean at a quiet resort a short distance north of Sydney.

As with his work, his retirement has been carefully planned and should therefore be a great success.

W.J.S.

Foreign aid activities

The Division of Food Research, in common with other Divisions of CSIRO, is taking part in a number of activities associated with Australia's foreign aid programs. In this way the Division's accumulated experience in food preservation and processing is made accessible to less developed countries, especially in the Asian region.

At the request of Asia Dairy Industries Ltd, Mr F. G. Kieseker (DRL) spent 3 weeks in Indonesia and Thailand during May and June 1977 to set up staff training schemes at the recombining plants in these countries. Mr D. McG. McBean (Food Technology Section, FRL) spent a month in Sri Lanka, India and Nepal, advising on solar drying of foods. His visit was sponsored by the Department of Science, on behalf of ASCA (Association for Science Cooperation in Asia). To give advice on fruit storage and handling, Mr G. B. Morgan (Engineering Section, FRL) and Mr E. G. Hall, formerly of FRL, travelled to Bhutan at the invitation of the Australian Development Aid Bureau (ADAB) of the Department of Foreign Affairs.

The Tasmanian Food Research Unit in conjunction with the University of Tasmania conducted a course on fish drying, including microbiological and analytical techniques, for South-East Asian personnel. Dr June Olley, Leader of the Unit, attended the second meeting of the Indo–Pacific Working Party on Fish Technology and Marketing, Colombo, Sri Lanka, and Mr S. J. Thrower (also TFRU) took part in an International Workshop on Marine Pollution in East Asian Waters held in Penang, Malaysia.

The Division's major involvement in foreign aid activities, however, is in a number of ASEAN–Australia economic cooperation programs funded by the Commonwealth Government under the aegis of ADAB. ASEAN is the Association of South-East Asia Nations which includes Indonesia, Malaysia, the Philippines, Singapore and Thailand.

Dr R. A. Buchanan of DRL was seconded to the Department of Foreign Affairs in 1973 as a Colombo Plan Expert at the Institute for Food Research and Product Development, Kasetsart University, Bangkok, Thailand. He assisted in the development of a new infant food for Thailand based on local raw materials — rice, soy and sugar. Following the success of this project he was appointed Australian Liaison Officer for the ASEAN Protein Project which was initiated to stimulate and coordinate research and development work on soy and other protein foods in the ASEAN region. Dr Buchanan, together with 13 members of the ASEAN Subcommittee on Protein, visited Australia in May–June 1977 and inspected the laboratories of MRL, FRL and DRL.

ASEAN has now undertaken another coordinated research program into post-harvest losses of foodstuffs, particularly rice, fruit, vegetables, meat and fish. Within this program a Postharvest Fruit and Vegetable Technology Project has been developed in three parts.

The first part was a short course in Post-harvest Fruit and Vegetable Technology held at the School of Food Technology, University of New South Wales, Kensington, for 8 weeks in June and July 1977. This course was attended by middle-level administrators from ASEAN countries who are expected to determine their country's priorities for research in this field. They were given an up-to-date summary of post-harvest fruit and vegetable technology; and extensive tours to horticultural production areas, packing houses and markets, and research establishments demonstrated current practices and research in Australia. A second short course may be given later.

The second part of the Project is the establishment of an ASEAN–Australia Postharvest Training and Research Centre at the University of the Philippines, Los Baños (UPLB) near Manila. This Centre, completed in July 1977, comprises teaching and research laboratories, controlled-temperature storage rooms, and an experimental packing house designed for use in teaching a 1-year postgraduate course in postharvest fruit and vegetable technology.

This course (the long course) will be taught by university staff at UPLB with assistance from visiting Australian experts. About three graduates from each ASEAN country will attend the long course which will be given each year for some years in order to build up expertise in postharvest technology, and a Certificate in Postharvest Technology of the University of the Philippines will be awarded to those graduating. Australian graduates may also take the course in the future. In addition, the Centre will be used for collaborative research among ASEAN research workers and also by Australian researchers working on tropical fruits and vegetables.

The third part of the Project will include the development of research facilities in each of the ASEAN countries. This will require the provision of equipment and facilities for existing and newly trained research workers to start on the research necessary to solve the region's many problems in tropical fruit and vegetable technology.

The Australian Steering Committee advising on the planning and development of the Postharvest Fruit and Vegetable Technology Project comprises Dr D. Graham (Chairman) and Dr W. B. McGlasson (both at FRL), Dr T. H. Lee and Dr R. B. H. Wills (both Senior Lecturers, School of Food Technology, University of New South Wales), Mr E. G. Hall (Consultant and formerly of FRL) and representatives of ADAB. Dr R. A. Buchanan is Australian Liaison Officer for the Project, attached to the Australian High Commission, Kuala Lumpur, Malaysia.

The ASEAN Sub-committee on Protein visited FRL on 31 May 1977. From left: Dr Amaret Bhumiratana (Thailand), Dr Roestamsjah, Dr Winoto, and Mr Suharto (Indonesia), Dr Y. H. Chong (Malaysia), Dr A. Bayan (Philippines), Dr A. Zaharudin (Malaysia), Mrs O. N. Gonzales (Philippines), J. F. Kefford (FRL), Prof. Oei Ban Liang (Indonesia), Dr R. A. Buchanan (Australian Liaison Officer), Miss Sjamsiah Achmad (Indonesia), Mr Kay Kong Lim and Mr Tang Teck Chye (Singapore), Mr M. Hashim Hassan (Malaysia).